# CLAIMS

We claim:

1. A method for making a positive active material, comprising the acts of:

exposing olivine or nasicon to a carbon source gas; and then

heating the carbon source gas to generate carbon material and deposit the carbon material on the olivine or nasicon.

2. The method of claim 1 wherein said olivine or nasicon comprises nasicon, $A_nB_2(XO_4)_3$, wherein

A is chosen from the group consisting of: Li, Ag, Cu, Na, Mn, Fe, Co, Ni, Cu, and Zn;

B is chosen from the group consisting of: Ti, V, Cr, Fe, and Zr;

X is chosen from the group consisting of: P, S, Si, W, Mo; and

n is between 0 and 3.

3. The method of claim 1 wherein said olivine or nasicon comprises olivine, $LiFe_{1-x}M_xPO_4$, wherein

M is chosen from the group consisting of Mn, Co, Ti, and Ni; and

$0 \leq x \leq 1$.

4. The method of claim 1 wherein said carbon source gas is heated to between 100°C and 1300°C to generate carbon material.

5. The method of claim 1 wherein said carbon source gas is heated to between 400°C and 700°C to generate carbon material.

6. The method of claim 1 wherein said carbon source gas is chosen from the group consisting of: acetylene, butane, 1-3 butadiene, 1-butene, Cis-2-butene, Trans-2-butene, 2-2 dimethylpropane, ethane, ethylene, isobutane, isobutylene, methane, propane, toluene, propylene, and mixtures thereof.

7. The method of claim 1 wherein said heating step occurs in a furnace chosen from the group consisting of: a fluidized bed furnace, a rotatory furnace, and a static furnace.

8. The method of claim 1 wherein said carbon source gas is mixed with an inert gas.

**9.** The method of claim **8** wherein said inert gas is chosen from the group consisting of: nitrogen, helium, argon, and mixtures thereof.

**10.** Positive active material made by the process of:
exposing olivine or nasicon to a carbon source gas; and
heating the carbon source gas to deposit carbon onto said olivine or nasicon.

**11.** The positive active material of claim **10** wherein said olivine or nasicon comprises olivine.

**12.** The positive active material of claim **10** wherein said olivine or nasicon comprises nasicon.

**13.** The positive active material of claim **10** wherein said olivine or nasicon contains pores and wherein said carbon is deposited within said pores.

**14.** The positive active material of claim **10** wherein the amount of deposited carbon is <15 wt%.

**15.** The positive active material of claim **10** wherein the amount of deposited carbon is about 4 wt% or less.

**16.** The positive active material of claim **10** wherein said carbon source gas decomposes at a temperature between 100°C and 1300°C to generate carbon.

**17.** The positive active material of claim **16** wherein said carbon source gas decomposes at a temperature between 400°C and 700°C to generate carbon.

**18.** The positive active material of claim **10** wherein said carbon source gas is chosen from the group consisting of: acetylene, butane, 1-3 butadiene, 1- butene, Cis-2- butene, Trans-2- butene, 2-2 dimethylpropane, ethane, ethylene, isobutane, isobutylene, methane, propane, toluene, propylene, and mixtures thereof.

**19.** The positive active material of claim **10** wherein said heating step occurs in a furnace chosen from the group consisting of: a fluidized bed furnace, a rotatory furnace, and a static furnace.

**20.** The positive active material of claim **10** wherein said carbon source gas is mixed with an inert gas.

**21.** The positive active material of claim **20** wherein said inert gas is chosen from the group consisting of: nitrogen, helium, argon, and mixtures thereof.

**22.** A positive electrode comprising:

a current collector; and

a coating on said current collector, said coating comprising a mix of the positive active material of claim 10 and a binder.

**23.** The electrode of claim **22** wherein said coating further comprises a conductive additive.

**24.** The electrode of claim **22** wherein said current collector is aluminum having a carbon coating thereon.

**25.** The electrode of claim **24** wherein the thickness of said carbon coating on said aluminum is less than 80 microns.

**26.** The electrode of claim **24** wherein the thickness of said carbon coating on said aluminum is less than 30 microns.

**27.** The electrode of claim **24** wherein the thickness of said carbon coating on said aluminum is less than 15 microns.

**28.** The electrode of claim **24** wherein the thickness of said carbon coating on said aluminum is less than 10 microns.

**29.** The electrode of claim **24** wherein the thickness of said carbon coating on said aluminum is about 3 microns or less.

**30.** The electrode of claim **24** wherein the thickness of said carbon coating on said aluminum is less than 2 microns.

**31.** A battery comprising:

a positive electrode comprising the positive active material of claim **10**;

a negative electrode; and

an electrolyte.

**32.** The battery of claim **31** wherein the amount of carbon deposited on said olivine or nasicon is <15 wt%.

**33.** The battery of claim **31** wherein the amount of carbon deposited on said olivine or nasicon is about 4 wt% or less.

**34.** The battery of claim **31** wherein said carbon source gas is a gas that decomposes at a predetermined temperature to generate carbon.

**35.** The battery of claim **34** wherein said temperature is between 100°C and 1300°C.

**36.** The battery of claim **31** wherein said carbon source gas is chosen from the group consisting of: acetylene, butane, 1-3 butadiene, 1- butene, Cis-2- butene, Trans-2- butene, 2-2 dimethylpropane, ethane, ethylene, isobutane, isobutylene, methane, propane, toluene, propylene, and mixtures thereof.

**37.** The battery of claim **31** wherein said carbon source gas is mixed with an inert gas.

**38.** The battery of claim **37** wherein said inert gas is chosen from the group consisting of: nitrogen, helium, argon, and mixtures thereof.

**39.** The battery of claim **31** wherein said electrolyte is a nonaqueous electrolyte.

**40.** The battery of claim **31** wherein said electrolyte comprises a salt dissolved in a solvent comprising at least one linear or cyclic carbonate.

**41.** The battery of claim **40** wherein said salt is chosen from the group consisting of: $LiClO_4$, $LiPF_6$, $LiBF_4$, $LiAsF_6$, $LiCF_3SO_3$, $Li(CF_3SO_2)_2N$, $Li(CF_3SO_2)_3C$, $LiN(SO_2C_2F_5)_2$, Li-methide, Li-imide, lithium alkyl fuorophosphate, lithium bis(chelato)borate, and a mixture thereof.

**42.** The battery of claim **31** wherein said negative electrode comprises a material chosen from the group consisting of: lithium metal, graphite, other carbon, $Cu_6Sn_5$, $Cu_2Sb$, MnSb, other metal alloys, $Li_4Ti_5O_{12}$, silica alloys, and mixtures thereof.

**43.** A positive electrode comprising:

a current collector comprising aluminum having a carbon coating thereon; and

a positive active material comprising olivine or nasicon on said current collector.

**44.** The positive electrode of claim **43** wherein the thickness of said carbon coating on aluminum current collector is less than 80 microns.

**45.** The positive electrode of claim **43** wherein the thickness of said carbon coating on aluminum current collector is less than 30 microns.

**46.** The positive electrode of claim **43** wherein the thickness of said carbon coating on aluminum current collector is less than 15 microns.

**47.** The positive electrode of claim **43** wherein the thickness of said carbon coating on aluminum current collector is less than 10 microns.

**48.** The positive electrode of claim **43** wherein the thickness of said carbon coating on aluminum current collector is about 3 microns or less.

**49.** The positive electrode of claim **43** wherein the thickness of said carbon coating on aluminum current collector is less than 2 microns.

**50.** The positive electrode of claim **43** wherein said positive active material is made by the process of:

exposing olivine or nasicon to a carbon source gas; and

heating the carbon source gas to deposit carbon onto said olivine or nasicon..

**51.** The positive electrode of claim **50** wherein the amount of carbon deposited on said olivine or nasicon is <15 wt%.

**52.** The positive electrode of claim **50** wherein the amount of carbon deposited on said olivine or nasicon is about 4 wt% or less.

**53.** A battery comprising:

a positive electrode comprising the positive active material of claim **41**;

a negative electrode; and

an electrolyte.

**54.** The battery of claim **53** wherein the amount of carbon deposited on said olivine or nasicon is <15 wt%.

**55.** The battery of claim **53** wherein the amount of carbon deposited on said olivine or nasicon is about 4 wt% or less.

**56.** The battery of claim **53** wherein said carbon source gas is a gas that decomposes at a predetermined temperature to generate carbon.

**57.** The battery of claim **56** wherein said temperature is between 100°C and 1300°C.

**58.** The battery of claim **53** wherein said carbon source gas is chosen from the group consisting of: acetylene, butane, 1-3 butadiene, 1- butene, Cis-2- butene, Trans-2- butene, 2-2 dimethylpropane, ethane, ethylene, isobutane, isobutylene, methane, propane, toluene, propylene, and mixtures thereof.

**59.** The battery of claim **53** wherein said carbon source gas is mixed with an inert gas.

**60.** The battery of claim **59** wherein said inert gas is chosen from the group consisting of: nitrogen, helium, argon, and mixtures thereof.

**61.** The battery of claim **53** wherein said electrolyte is a nonaqueous electrolyte.

**62.** The battery of claim **53** wherein said electrolyte comprises a salt dissolved in a solvent comprising at least one linear or cyclic carbonate.

**63.** The battery of claim **62** wherein said salt is chosen from the group consisting of: $LiClO_4$, $LiPF_6$, $LiBF_4$, $LiAsF_6$, $LiCF_3SO_3$, $Li(CF_3SO_2)_2N$, $Li(CF_3SO_2)_3C$, $LiN(SO_2C_2F_5)_2$, Li-methide, Li-imide, lithium alkyl fuorophosphate, lithium bis(chelato)borates, and mixtures thereof.

**64.** The battery of claim **53** wherein said negative electrode comprises a material chosen from the group consisting of: lithium metal, graphite, other carbon, $Cu_6Sn_5$, $Cu_2Sb$, MnSb, other metal alloys, $Li_4Ti_5O_{12}$, silica alloys, and mixtures thereof.